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The molluscs of the Duddingston Loch area, Edinburgh, Scotland: comparison of the present with the 19th and 20th centuries

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ABSTRACT

The molluscan fauna of Duddingston Loch, Edinburgh, Scotland and surrounding areas has been studied in recent years, and compared with earlier reports, particularly that of D.K. Kevan in 1929–1930. Ten freshwater mollusc species that were recorded in the past have not been found in recent years, while other species have arrived and flourished. Reasons for such changes may include adverse effects of algal blooms and the introduction of certain fish. The terrestrial mollusc fauna in the Duddingston Loch area has not changed in the same way, but several alien species that have become widespread in the Edinburgh area and in Scotland generally have also appeared here. As a result, a total of 76 species of mollusc has been recorded in the Duddingston Loch area, making this one of the richest sites for molluscs in Scotland.

INTRODUCTION

Duddingston Loch is the largest remaining freshwater body in the city of Edinburgh, Scotland and has attracted the attention of naturalists since the early part of the 19th century, if not earlier. The earliest records of molluscs appear to be those published by Rhind (1836). Since then, occasional records from a number of sources have been published, but the most notable survey was that of D.K. Kevan in 1929 and 1930 with A.R. Waterston (Kevan, 1931). Kevan recorded 44 species of mollusc living in the region of Duddingston Loch, which made it it one of the richest sites for non-marine molluscs in Scotland. Since 1930, several alien species of slugs and snails have entered the country, and there have also been changes in Duddingston Loch and the surrounding areas.

In recent years I have had the opportunity to visit many of the habitats around Duddingston Loch, and have also been able to study literature pertaining to molluscs in the area, and to examine the collections in the National Museums of Scotland. Consequently, a detailed account of the molluscan fauna of the Duddingston Loch area can be provided, and changes in that fauna over the last two centuries or so can be recorded.

Duddingston Loch (Fig. 1) lies immediately to the south-east of Arthur's Seat in Edinburgh (NT2872). The loch and its immediately surrounding area, occupying about 25 ha, was designated a Bird Sanctuary in 1925 (NatureScot, 2023). The loch itself is shallow, with an

Fig. 1. Duddingston Loch, Edinburgh, Scotland. (Photo: A.T. Sumner)

average depth of 2.2 m (Historic Environment Scotland, undated), and a maximum depth of 3 m (Gazetteer of Scotland, 2022); the bottom of the loch is soft mud (Kevan, 1931). At the western end of the loch is a marshy area, including Wells o' Wearie, which appears to be the main site of inflowing water for the loch. The Duddingston Loch area has since been designated as a Site of Special Scientific Interest (SSSI) (NatureScot, 2023). In addition to the SSSI, the Scottish Wildlife Trust (SWT) has a reserve, Bawsinch, at the south-east corner of the Duddingston Loch SSSI, and since 1971 has managed the SSSI as well as Bawsinch. Bawsinch is an area of trees and scrub, with swampy areas and ponds, leading to the reed beds on the south side of the loch. A wall runs along the south side of the site, separating it from the former Innocent Railway, now a foot- and cycle-path. Since 1963, an area at the north-east corner of the loch has been developed as Dr Neil's Garden, an ornamental garden open to the public, sloping down from Duddingston village to the loch shore (www.drneilsgarden.uk). A sketch map of these areas is provided as Fig. 2.

Duddingston Loch is eutrophic, with extensive reed beds (*Phragmites* sp.). A survey in 2015 found that the SSSI was in an unfavourable condition. Phosphorus levels in the water were high; pH was just on the acid side of neutrality. Algal blooms have occurred in the past, which have probably affected the fauna of the loch adversely; restocking with carp after such a bloom may

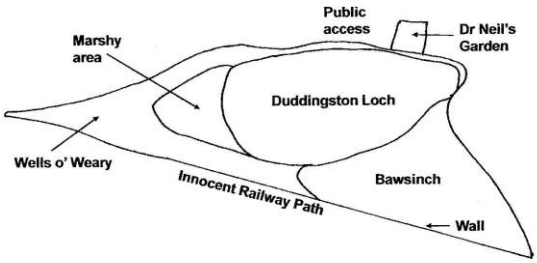

Fig. 2. Sketch map showing the Duddingston Loch SSSI, the SWT Bawsinch reserve, and Dr Neil's Garden. Not to scale.

also have had deleterious effects on other species. At the edges of the loch, woodland has been gradually encroaching on the reedbeds, and attempts have been made to reverse this (NatureScot, 2023; EnviroCentre Ltd., 2015).

METHODS

Land and freshwater molluscs were sampled from the public access at the north side of the loch during 2015 to 2019, from Dr Neil's Garden during a Bioblitz organised by the Royal Society for the Protection of Birds in 2016, and throughout Bawsinch in 2015. Land molluscs were sought by visual searching of vegetation, turning over debris such as stones and pieces of wood, and by examining walls and the vegetation growing on them. Freshwater species were collected from the bank of the loch using a hand net with a 1 mm mesh.

Historical records were extracted from books and periodicals in the National Library of Scotland, and through use of the Biodiversity Heritage Library. Journals examined included *Journal of Conchology*, *Scottish Naturalist*, etc. Actual specimens from the 19th century up to recent times were examined in the collections of the National Museums of Scotland. Binomial names used are those given by Anderson & Rowson (2020), with names used by earlier authors updated accordingly.

Records are submitted to the Conchological Society of Great Britain and Ireland's database, from which they are copied to the National Biodiversity Network (NBN).

RESULTS

Species recorded by D.K. Kevan (Kevan, 1931) and by the author are listed in Table 1 (freshwater species) and Table 2 (terrestrial species). Many of these species had also been recorded by various authors in the 19th and early 20th centuries (Rhind, 1836; White, 1873–4; Bennie & Scott, 1888–90; Roebuck, 1890; Crapper, 1922; Ritchie, 1923). Table 3 lists species not seen by D.K. Kevan or the present author, but that were recorded by others. Table 4 lists species found at Duddingston Loch which have arrived in the Edinburgh area since Kevan conducted his study in 1929–30.

Species	D.K. Kevan's records[1]	Present author's records	Earliest records
Gastropods			
Acroloxus lacustris	present	1 (B)	Rhind, 1836
Ampullaceana balthica	plentiful		Bennie & Scott, 1888–1890
Anisus leucostoma	present		Rhind, 1836
Anisus vortex		abundant (B,D)	
Bathyomphalus contortus	abundant		Rhind, 1836
Bithynia tentaculata	fairly scarce	abundant (B,D)	
Galba truncatula	present		Roebuck, 1890
Gyraulus crista	fairly common	several (D)	Bennie & Scott, 1888–1890
Gyraulus laevis	present		Roebuck, 1890
Hippeutis complanatus		1 (D)	
Lymnaea stagnalis	sparse	a few (B,D)	Crapper, 1922
Physa fontinalis	sparse	many (D)	Bennie & Scott, 1888–1890
Planorbarius corneus		1 (B)	
Planorbis carinatus		abundant (B,D)	
Radix auricularia	present		Roebuck, 1890
Stagnicola sp.	abundant		Rhind, 1836
Valvata cristata		1 (D)	Rhind, 1836
Valvata piscinalis		empty shells (D)	Rhind, 1836
Bivalves			
Anodonta cygnea		1 (D)	Rhind, 1836
Euglesa casertana	present		Rhind, 1836
Euglesa milium	present		Roebuck, 1890
Euglesa nitida		1 (D)	
Euglesa personata	present		Roebuck, 1890
Euglesa subtruncata		1 (D)	
Sphaerium corneum	not plentiful	1 (D)	Roebuck, 1890

Table 1. Freshwater mollusc species found in the Duddingston Loch area, Edinburgh, Scotland. [1]Kevan (1931). B, Bawsinch; D, Duddingston Loch.

Species	D.K. Kevan's records [1]	Present author's records	Earliest records
Aegopinella nitidula	present	several (B,N)	
Arion ater agg.	not common		
Arion circumscriptus	present		
Arion distinctus	present	few (B,N)	Roebuck, 1890
Arion intermedius	present	few (B)	
Arion rufus		1 (N)	
Arion subfuscus		few (B,N)	
Balea perversa s.s.	present	several (B)	NMS, 1872
Carychium minimum	present		
Cepaea nemoralis	broken shells	several (B)	
Cochlicopa cf. *lubrica*	present	many (B)	
Cornu aspersum	broken shells	many (B,N)	
Deroceras laeve	common	a few (D,N)	
Deroceras reticulatum	present	many (B,N)	Roebuck, 1890
Discus rotundatus	present	few (B,N)	Roebuck, 1890
Euconulus fulvus[2]	present		
Lauria cylindracea	present	a few (D,N)	
Lehmannia marginata	present	a few (B)	
Limax maximus		several (B,N)	
Nesovitrea hammonis	present		
Oxychilus alliarius	present	a few (B,N)	
Oxychilus cellarius	present	several (B,D,N)	
Oxychilus draparnaudi	present	1 (B)	
Oxyloma elegans	present	several (B,D)	
Pyramidula pusilla			Roebuck, 1890;
Succinea putris[3]	present		
Trochulus hispidus	present	1 (B)	
Vallonia cf. *excentrica*	present		
Vertigo antivertigo	present		
Vertigo pygmaea	present		Roebuck, 1890
Vitrea crystallina	present		
Vitrina pellucida	present		
Xeroplexa intersecta	present		
Zonitoides nitidus	present	several (B,D)	

Table 2. Terrestrial mollusc species found in the Duddingston Loch area, Edinburgh, Scotland. [1]Kevan, 1931; [2]subsequently redetermined as *Euconulus alderi* by NMS and confirmed by the author; [3]subsequently redetermined as *Oxyloma elegans* by M.P. Kerney. B, Bawsinch; D, Duddingston Loch; N, Dr Neil's Garden.

Species	Records
Terrestrial gastropods	
Aegopinella pura	NMS, 1930
Pyramidula pusilla	Roebuck, 1890; NMS, 1890
Freshwater gastropods	
Gyraulus albus	Rhind, 1836
Planorbis planorbis	NMS, 1866–1894; Rimmer, 1880
Bivalves	
Anodonta anatina	NMS, 1933
Euglesa lilljeborgii	Kerney, 1968
Euglesa obtusalis	Rhind, 1836
Sphaerium lacustris	Rhind, 1836

Table 3. Species not recorded by D.K. Kevan or the present author. NMS indicates records obtained from specimens in the collections of the National Museums of Scotland (NMS).

Species	First record in Edinburgh[1]	Status at Duddingston
Ambigolimax valentianus	2000	several (D,N)
Arion flagellus	1996	a few (B,D,N)
Arion owenii	2001	many (B,D,N)
Arion vulgaris	2013	a few (B,N)
Boettgerilla pallens	1996	a few (B)
Deroceras invadens	1931	2 (B)
Hygromia cinctella	2012	a few (B)
Limacus maculatus	1981	several (B,N)
Potamopyrgus antipodarum	1956	1 (D)
Trochulus striolatus	1965[2]	many (B,D,N)

Table 4. Species that have arrived in Edinburgh in recent years. [1]Obtained from National Biodiversity Network records; [2]a very few earlier records. B, Bawsinch; D, Duddingston Loch; N, Dr Neil's Garden.

DISCUSSION

Kevan (1931) recorded 44 species of molluscs in the Duddingston "Sanctuary". Further studies, including the author's own, have increased this total to no fewer than 76, not all of which, however, have been recorded as being present at the same time. There are species that were recorded by Kevan which I have not found, and *vice versa*; in addition, there are species recorded by neither of us, but which have been recorded by others. For example, of the 16 freshwater species recorded by Kevan (1931), only six were found by the present author; and 11 freshwater species have been recorded subsequently that were not seen by Kevan. Kevan (1931) also recorded 29 species of terrestrial molluscs, but only 18 of these were found by the present author; another 12 terrestrial species have been recorded that Kevan did not see, in many cases because they were recent immigrants (Table 4). There are several factors that could be responsible for the failure to find certain species. Several species are very small (e.g. *Vertigo* spp. and *Euglesa* spp.) and might be overlooked, although still present. Other species might have been missed because they are uncommon, or have a localised distribution within the area (e.g. *Galba truncatula*). In some cases, particularly with older records, there may be uncertainty about the identification of certain species, because of changing taxonomic knowledge. For example, *Oxyloma elegans* and *Succinea putris* cannot be distinguished reliably on external characters alone, and the characters for identifying them by internal anatomy were not resolved until 1933 (Quick, 1933). Finally, the areas studied by different authors are never defined precisely, but in any case Kevan studied the marshy areas at the west end of the loch, which I was unable to access, while both Bawsinch and Dr Neil's Garden, which I visited, did not exist in their current form in 1930.

Table 1 shows that there are several freshwater species that were common in 1930 but have not been found in recent years, and species that were apparently absent in 1930 but are now common. *Ampullaceana balthica* (formerly *Lymnaea peregra*, a generally common snail) and *Bathyomphalus contortus* were found at various sites at Duddingston in 1929, but have not been found recently. *Stagnicola* sp., formerly abundant, has also not been recorded recently. *Radix auricularia* is another species recorded by Kevan that has not been seen in recent years; in fact, it seems to have been lost from Edinburgh and the surrounding areas, and no live animals have been seen for many years (Kerney, 1999; pers. obs.)

There are two situations in which one species may have replaced another. Kevan (1931) found that *Anisus leucostoma* was common in the marshy areas at the west end of the loch, although it has not been seen since, while *A. vortex*, not recorded by Kevan, is now common. Similarly, *Planorbis planorbis*, though not seen by Kevan, used to be abundant at Duddingston (Rimmer, 1880; Kevan, 1931); now it is the very similar *P. carinatus* that is abundant. It should be noted that the disappearance of *P. planorbis* and the spread of *P. carinatus* is general in the Lothians in recent years (pers. obs.). Another species that seems to have increased at Duddingston in recent years is *Bithynia tentaculata*, fairly scarce in 1929 (Kevan, 1931), but now abundant. The swan mussel, *Anodonta cygnea*, is an interesting case, as Kevan (1931) stated that nothing lived on the soft mud bottom of the loch, although this species was, apparently, known to Rhind (1836). However, even before it was recorded in 2016, otters (*Lutra lutra*) had been seen catching and eating swan mussels (the late Ken Knowles, pers. comm.). In fact, the swan mussel can lie flat on the surface of soft mud and not sink in (Killeen *et al*., 2004), so is well adapted to habitats such as that found in Duddingston Loch. A record of duck mussels, *A. anatina*, seems anomalous, but I have examined specimens in the National Museum of Scotland collections, and the determination appears to be correct. Species that have disappeared from Duddingston Loch might have been adversely affected by algal blooms (EnviroCentre, 2015), or by subsequent introduction of fish, particularly carp (NatureScot, 2023). However, *P. planorbis* seems to have gone well before any such events had been recorded. Species which have increased in recent years, such as *P. carinatus* and *A. vortex*, may simply have been able to exploit niches left vacant by the effects of algal blooms, or could have been introduced when the loch was restocked with fish. Introduction by water birds is another likely mechanism (Kew, 1893).

None of the terrestrial species found in the Duddingston area seems to have shown the dramatic changes undergone by some of the freshwater species. *Cepaea nemoralis* and *Cornu aspersum* were recorded by Kevan (1931) only as "broken shells", whereas I found them to be common; similarly, the slug *Limax maximus* was not recorded by Kevan, but I found several when I visited the area. However, these species were found particularly in Bawsinch and Dr Neil's Garden, which were not visited by Kevan.

Finally, the ten species should be noted that have arrived in Scotland, and the Edinburgh area, in recent years (Table 4). Many of these species are alien invaders (Kerney, 1999; Rowson *et al.*, 2014), and are now widespread in and around Edinburgh, and it is hardly surprising that they have turned up in the Duddingston area.

In conclusion, there have been many changes in the molluscan fauna of the Duddingston area since the earliest records were made early in the 19th century (Rhind, 1836). This becomes particularly clear when recent records are compared with the comprehensive studies of Kevan (1931); some species present in the past are no longer seen, and others have arrived that were not recorded earlier. This is particularly true of freshwater species in Duddingston Loch itself, which may have been affected by algal blooms and introduced fish. On land, however, the main difference is the arrival of several largely alien species that have become widespread in the Edinburgh area and other parts of Scotland in recent years. No doubt there will be further changes in the future, and it is hoped that continued monitoring of well recorded sites such as Duddingston will help in understanding the reasons for such changes.

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